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ABSTRACT

This study examined: (1) the relationship between the fulfillment of expectations for the identification of rocks and minerals after experience with specimens selected to meet expectations and anxiety levels; (2) changes in anxiety levels after this experience was followed by experience with rocks and minerals which did not meet expectations; and (3) relationships between anxiety levels and achievement. Subjects (N=27 preservice elementary teachers) completed a demographic questionnaire, rock/mineral response sheets, and the State-Trait Anxiety Inventory (STAI), measuring state anxiety (transitory emotional state influenced by training) and trait anxiety (relatively stable individual difference in anxiety proneness). Results indicate among others that when students' expectations about rock/mineral identification were met their anxiety about teaching rocks/minerals as measured by the STAI (state) was reduced significantly, suggesting that anxiety about science and science teaching may be reduced by classroom teachers identifying subject areas or procedures which evoke anxiety and providing conscious efforts for structured success. Correlations between achievement and trait anxiety were not significant. (Author/JN)

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ANXIETY REDUCTION IN PRESERVICE ELEMENTARY TEACHERS AND THE FULFILLMENT OF EXPECTATIONS FOR IDENTIFICATION OF MINERALS AND ROCKS

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Abstract

Results of this pilot study indicates that anxiety about teaching minerals and rocks in preservice elementary teachers is reduced when expectations for identification are met.

If these conclusions are supported by further research, then anxiety reduction in the classroom should be a concern of researchers in science education.

Anxiety Reduction in Preservice Elementary Teachers and the Fulfillment of Expectations for Identification of Minerals and Rocks

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Many science educators mention that elementary teachers are "frightened" of science and avoid teaching the subject. Students in K-3 spend an average of less than 20 minutes a day on science, less time than any other subject. (NSF, 1980, p. 9)

Research studies in the field of psychology and interest in "science anxiety clinics" (Mallow, 1981) focus attention on the possible role of anxiety in the avoidance of science study. Although there are many studies in the field of psychology which focus on anxiety in academic settings, (Spielberger, 1966, 1972; Gaudry and Spielberger, 1971; and Gaudry, 1977) only a few studies have been done in the field of science education which include measurement of anxiety about science or science teaching (Terrell, 1974; Harmon, 1977; Bitner, 1978; Kozma, 1982 and Westerback, 1982).

Shymansky's (1978) review article indicates that teaching strategy is related to student anxiety and performance levels. The review article implies that because all students do not learn equally well from all modes of instruction the creation of a learning environment where students of different personalities and learning aptitudes can be sucessful regardless of instructional mode may be an important issue.

Kozma's (1982) study of college students in a chemistry laboratory focused on instructional design, but included measurement of trait anxiety. This study indicates that the interaction among instructional treatment, ability and anxiety is complex.

Spielberger and his co-workers indicate that state anxiety is likely to be aroused in situations of failure or threats to self esteem (Gaudry, 1977). King, Heinrich, Stephenson and Spielberger (1976) infer that trait anxiety exerts a causal effect on both state anxiety

and achievement and that state anxiety influenced achievement. It seems reasonable to anticipate that success and the fulfillment of expectations of achievement would reduce anxiety levels about that task. No studies were found which examined these relationships.

Purpose

The purpose of the researchers in this study was to examine 1. the relationship between the fulfillment of expectations for the identification of minerals and rocks after experience with specimens selected to meet their expectations and anxiety levels; 2. changes in anxiety levels after this experience was followed by experience with minerals and rocks which did not meet their expectations; and 3. to examine the relationships between anxiety levels and achievement in both cases.

Method

Subjects

Twenty seven preservice elementary teachers enrolled in General Science at C. W. Post Center, a four year liberal arts college, participated in this study. All the subjects were women sophomores, juniors and seniors whose mean age was 22 years. All students had taken high school biology, about half had taken high school chemistry and high school earth science, and one student elected high school physics. About half of the students had taken college biology. Less than 15% of the students had taken college level earth science or physical science. Students enjoyed high school and college science at a ratio of 4:1 like/dislike. Most of the students had taken high school algebra, geometry and intermediate algebra and completed at least one semester of college math. The enjoyment ratio for high school and college math was similar to the enjoyment ratio for science. The students were very similar in background to preservice students studied by Westerback (1982).

The sample consisted of two subgroups, Group I (N=13), students of Teacher A and Group II (N=14). students of Teacher H. All students in Teacher A's class were included in the study, but 8 of the 22 students in Teacher H's class were eliminated because of incomplete data (dropped course, illness or late registration). Study was conducted Spring 1982.

All students registered for two mandatory courses, either Science 15A (earth science) or Science 15 (earth science-biology). The geology segment in which the investigation took place was the same in both courses. Students in Science 15A (Group I) all had completed a prerequisite of at least one semester of college biology. There were no prerequisites to register in Science 15 (Group II). However about half of the students had completed at least one semester of college biology.

Science 15A (Group I - earth science) was taught by Teacher A. The class met three time a week (three 50 minute sessions). Science 15 (Group II earth science-biology) was staffed by Teacher H (earth science) and Teacher J (biology). Teacher J, the Coordinator of the General Science Program, arranged the teaching schedule for Science 15 so that the day classes met twice a week for two 75 minute sessions and the evening class met once a week for one 150 minute session. The biology component of the day section was taught on Tuesday (75 minutes) and the earth science component was taught on Thursday (75 minutes). In the evening class the earth science component was taught during the first half of the semester, followed by the biology component. Teacher A (Science 15-A, Group I) completed the study of minerals and rocks and the collection of data in three consecutive weeks (450 minutes). Teacher H (Science 15, Group II) completed the study of minerals and rocks and the collection of data in 8 consecutive Thursday day classes (560 minutes) and after 4 consecutive evening classes (600 minutes). As the sample size was small (N=14), the 10 day students and 4 evening students were treated as a single group because the teacher and the subject matter were the same.

Instruments

Demographic Questionnaire

Demographic data were collected on the following variables: ID, age, sex, college standing, high school and college science and math backgrounds, level of enjoyment of science and math courses and educational specialization (elementary or special education). Additional data were gathered from an open ended optional question with opportunity for responses about experiences which the individual felt may have influenced his/her feelings about teaching science.

Response Sheets A and B

Data were collected on Response Sheet A on confidence about teaching minerals and rocks after experience with minerals and rocks with clearly defined criteria and whether or not expectations for identification had been met. Space was provided for optional comments.

Data were collected on Response Sheet B on confidence about teaching minerals and rocks after experience with minerals and rocks with no clearly defined criteria for identification and whether or not expections for identification had been met. Students were asked to respond to the following questions: If there were no clues -- how did you deal with this? How will you deal with rocks that cannot easily be identified when you are teaching? Do you think this will be a problem? Why or why not?

The State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI) consists of two scales, State anxiety (A-state), a transitory emotional state which can be influenced by training, and Trait anxiety (A-trait), relatively stabel individual differences in anxiety proneness (Spielberger, Gorsuch and Lushene, 1970). The X form, published in 1970 has been widely used. The Y form, which has recently been developed, was sent to the researcher by Spielberger prior to the publication of the manual for its use.

The A-state scale consists of 20 items like "I feel calm", "I feel self-confident" and "I feel confused". The subject is asked to respond to each item by rating the intensity of his feelings. When an individual perceives a situation as threatening the A-state will be elevated. Because the A-state scale reflects situational influences at the time of testing, coefficient alphas measured of internal consistency were computed. For the X form Spielberger, Gorsuch and Lushene (1970) found these reliability coefficients ranged from .83 to .92. For the Y form Westerback (1982) found the reliability coefficent for 103 preservice elementary teachers during the Spring 1981 semester was .95.

The A-trait scale consists of 20 items like "I feel like a failure", "I make decisions easily" and "I am content". Spielberger, Gorsuch and Lushene (1970) report test-retest correlations for the A-trait scale, form X ranging from .73 to .86. For the Y form Westerback (1982) found the coefficient alpha for 103 preservice elementary teachers was .92.

The heading on the A-state scale was changed with Spielberger's permission from "Self Evaluation Questionnaire" to "How Do You Feel About Teaching Students to Identify Minerals and Rocks?". The heading on the A-trait scale was changed from "Self Evaluation Questionnaire" to "How Do You Feel in General". The instruments were not altered.

Procedure

The purpose of the research was explained to the students on the first day of class. The directions for the administration of the STAI (Appendix) were read prior to the administration of the A-state and A-trait scales. This was followed by the administration of the Demographic Questionnaire.

After the unit on minerals and rocks was completed the students were asked to distinguish 9 rocks and minerals from each other. If the specimen was a rock they were asked to categorize it as igneous, sedimentary or metamorphic and in each case state the reasons for identification. The exam was corrected in the presence

of the student, allowing for questions and feedback. Immediately, the STAI was administered, followed by Response Sheet A. At the next class meeting students were given five minerals and rocks to classify which did not exhibit obvious characteristics for identification. Students were told these specimens would count as bonus credit. The bonus exam was corrected in the students presence, followed by the administration of the STAI and Response Sheet B.

Results

The results of this study are presented based on the following questions:

1. Was anxiety about teaching minerals and rocks reduced when expectations for identification were met and was the anxiety level changed when expectations for identification were not met in subsequent samples?

Table 1 presents the means, standard deviations, and analysis of variance for three successive administrations of the STAI (state) for the total sample, Groups I and II. It can be seen that anxiety about teaching minerals and rocks was changed positively across the three administrations of the STAI. For the total group (N=27) $F = 19.27$, d.f. 2, 54, $p < .001$. For Group I (Science 15A - earth science, N=13) $F = 14.97$, d.f. 2, 24, $p < .001$. For Group II (Science 15 - earth science-biology, N=14), $F = 7.11$, d.f. 2, 26, $p < .01$.

In order to determine which of the three administrations of the STAI were significantly different from each other, Tukey's HSD (honestly significant difference) multiple comparison technique (Kirk, 1968) was computed. The results show that for both the total sample and Group I the change between the first and second administrations was significant at the .01 level. For Group II the change was significant at the .05 level between the first and second administrations. In all cases the change between the second and third administrations was not significant.

Table 1

Means, Standard Deviations and Analysis of Variance (Repeated Measure) of State Anxiety About Teaching Minerals and Rocks Using the STAI

	First Administration	Second Administration	Third Administration
Total (N=27)			
Mean	48.19	34.41	35.11
S. D.	12.75	11.60	8.46
Group I (N=13)			
Mean	51.31	31.15	35.46
S. D.	13.34	7.07	7.31
Group II (N=14)			
Mean	45.29	37.43	34.78
S. D.	11.91	13.52	9.66

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Total				
STAI	2	3251.28	1625.64	19.27[a]
Residual	52	4386.72	84.36	
Group I				
STAI	2	2928.62	1464.31	14.97[a]
Residual	24	2348.05	97.84	
Group II				
STAI	2	835.19	417.60	7.11[b]
Residual	26	1526.83	58.70	

[a] Significant at the .001 level.

[b] Significant at the .01 level.

Table 2 presents the percentage of students whose expectations about teaching minerals and rocks was fulfilled and whose confidence about teaching minerals and rocks was changed. After the examination with specimens showing clearly defined criteria for identification (second administration of the STAI), all groups show 100% fulfillment of expectations and more than 90% increase in confidence. After the examination with specimens without clearly defined criteria for identification (third administration of the STAI), 38% of the students in Group I and 79% of the students in Group II perceived that their expectations for identification had been met. Twenty three percent of the students in Group I and 7% of the students in Group II reported their confidence was decreased after this experience.

Table 2

Percentage of Students Whose Expectations About Teaching Minerals and Rocks was Fulfilled and Percentage of Students Whose Confidence About Teaching Minerals and Rocks was Changed

	Fulfillment of Expectation		Confidence About Teaching Minerals and Rocks		
	Yes	No	Increased	Same	Decreased
After Exam With Specimens With Clearly Defined Criteria					
Total (N=27)	100		96	4	
Group I (N=13)	100		100		
Group II (N=14)	100		93	7	
After Exam With Specimens Without Clearly Defined Criteria					
Total (N=27)	59	41	67	18	15
Group I (N=13)	38	62	69	8	23
Group II (N=14)	79	21	64	29	7

Comments on Response Sheet A (given after exam with specimens with clearly defined criteria -- second STAI) follow: Nineteen of the 27 subjects volunteered comments. Responses in order of frequency were: exam was fair, samples easy, they were able to analyze categories and more experience with minerals and rocks would be beneficial.

Comments on Response Sheet B (given after exam with specimens without clearly defined critiera -- third STAI) follow: In answer to question: If there were no clues -- how did you deal with this? The responses were: try to figure it out and guess. In response to the question: How will you deal with rocks and minerals that cannot easily be identified when you are teaching? Comments in order of frequency were: Be honest, say you are not sure and provide a means to find the answer, i.e., look it up, ask someone, have the students find the answers, and one response stick to the easy samples. In response to the question: Do you think this will be a problem? (when teaching) Why or why not? Twenty one students said NO, 4 maybe and 2 yes. The availability of reference materials and assistance from others provided support. Seventy five percent of the students in Group I (earth science) stated they would have been frustrated if the difficult specimens had been included in the initial exam. None of the students in Group II (earth science-biology) made this comment.

On the Demographic Questionnaire 22 of the 27 subjects responded to the question: Do any experiences or individuals (teachers, parents, siblings, peers) stand out in your mind as influencing your feelings about teaching science in either a positive or negative way? Nineteen indicated their experiences were positive, 3 reported negative experiences. All students cited the teacher as influencing their experience.

Table 3 presents the means, standard deviations and analysis of variance for three successive administrations of the STAI (trait) for the total samples and Groups I and II. It can be seen that trait anxiety remained relatively constant in all groups.

Table 3

Means, Standard Deviations and Analysis of Variance (Repeated Measure) of Trait Anxiety

	First Administration	Second Administration	Third Administration
Total (N=27)			
Mean	35.74	32.19	32.19
S.D	7.88	8.38	8.43
Group I (N=13)			
Mean	34.62	31.92	32.69
S. D.	5.15	6.61	7.99
Group II (N=14)			
Mean	32.93	32.43	31.71
S. D.	9.89	9.90	9.08

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Total				
STAI	2	43.56	21.78	2.37
Residual	52	477.11	9.18	
Group I				
Mean	2	50.00	25.00	2.41
Residual	24	249.33	10.39	
Group II				
Mean	2	10.43	5.21	.64
S. D.	26	210.90	8.11	

2. Were the mean STAI scores (state and trait), and achievement scores significantly different for students in Groups I and II?

Computation of t-tests show that none of the STAI scores were significantly different for students in Groups I and II. In order to determine if the magnitude of the difference between the reduction of anxiety in Group I (-20.15 points) and Group II (-7.85 points), at STAI-2, was significant a t-test was computed. The difference was significant. ($t = -2.23$, d.f. 25, $p < .05$)

In order to determine if the average grade of 94 % on the examination with specimens with clearly defined criteria, for students in Group I was significantly from the average grade of 81 % for students in Group II, a t-test was computed. The difference was significant. ($t = 2.13$, d.f. 25, $p < .05$) The bonus exam had a maximum value of 5 points. The bonus exam called for identification of specimens which did not show clearly defined criteria for identification. In order to determine if the mean score of 2.9 for students in Group I was significantly different from the mean score of 3.8 for students in Group II a t-test was computed. The difference was significant. ($t = -2.40$, d.f. 25, $p < .05$)

3. What relationships exist among A-state, A-trait and achievement measures?

Table 4 shows correlation coefficients between STAI scores (state and trait) and grades after the exam with specimens with clearly defined criteria and correlation ceofficients between STAI scores (state and trait) and grades after the exam with specimens without clearly defined criteria (bonus).

It can be seen that none of the correlation coefficients between achievement and trait anxiety are significant. The strongest relationship between state anxiety and achievement is exhibited when there is the widest range of examination grades.

Table 4

Correlation Coefficients Between Grades and Anxiety as Measured by the STAI

	Group I	Group II	Total
After Exam With Specimens With Clearly Defined Criteria			
State anxiety	.50[c]	-.74[a]	-.52[c]
Trait anxiety	-.39	-.21	-.25
After Exam With Specimens Without Clearly Defined Criteria			
State anxiety	-.73[b]	-.02	-.33[c]
Trait anxiety	-.38	.02	-.19

[a] Significant at the .001 level.

[b] Significant at the .01 level.

[c] Significant at the .05 level.

Discussion

Although the sample is similar in demographic characteristics to previously studied samples of preservice elementary teachers (Westerback, 1982) the small sample size necessitates caution in drawing conclusion which can be generalized. This is a pilot study. However, several trends can be noted.

When students' expectations about identification of minerals and rocks were met their anxiety about teaching minerals and rocks as measured by the STAI (state) was reduced significantly.

In this study, the patterns of anxiety reduction were different for students in Groups I and II. After an examination with specimens with clearly defined critieria for identification (initial exam), the mean anxiety scores of students in Group I dropped sharply. After an examination with specimens which did not exhibit clearly defined criteria for identification (bonus exam), there was an increase in anxiety which was not significant. The mean anxiety scores for students in Group II dropped after the initial exam, but the drop was significantly less than mean scores for students in Group I. However, after the bonus exam, the mean anxiety scores of students in Group II continued to drop.

Three possible explanations are propsed by the researchers: 1. teacher differences, 2. scheduling variation, and 3. different student perceptions about criteria for identification of minerals and rocks.

Both teachers (A and H) used a lecture format, supplemented by the same slide presentation and the same hand specimens of minerals and rocks. For several years these two teachers worked in a cooperative and supportive manner in the development of the course content for the segment in which the research was conducted. In a previous study (Westerback, 1982), there was no significant difference in the reduction of anxiety about teaching science between students in the classes of the two teachers.

It is possible that scheduling variations may account for some of the differences between the groups. The day schedule, which required the subjects to study two academic disciplines, biology on Tuesday and earth science on Thursday, taught by two different teachers (H and J) with different goals and teaching styles, could be a confounding factor. This "split" schedule extended the time to complete the unit on minerals and rocks from the usual 3-4 week period to 8 weeks. As the biology teacher (J) and the earth science teacher (H) did not communicate with each other, examinations for both disciplines were scheduled for the same week.

Perhaps the scheduling is related to achievement, expectations and confidence. The students with uninterrupted instruction (Group I) had an average grade on the initial exam of 94%. The corresponding grade for Group II students was 81%. However, Group II was composed of two subgroups, a day and evening group. The average grade in the evening section, where instruction was uninterrupted (N=4) was 100%. The average grade in the day section with the "split" schedule (N=10) was 64%.

After the initial exam the expectations for fulfillment of criteria for identification of minerals and rocks was 100% for both Groups I and II. After the bonus exam, 79% of the students with high achievement (Group II) stated their expectations had been met, while 38% of the students with low achievement (Group I) stated their expectations had been met.

Confidence levels were similar for both groups after the initial exam. After the bonus exam, 23% of the students with low achievement (Group I) stated their confidence had decreased, and 7% of the students with high achievement (Group II) stated their confidence had decreased. In summary, after the bonus exam, the students with high achievement perceived that their expectations had been met and few students reported a decrease in confidence levels. The faculty did not believe that the difficult specimens had clearly defined criteria.

The small class size and supportive atmosphere provided many opportunities for interaction of students and faculty. The comments reported in Response Sheets A and B are reflective of statements made to the faculty. We were pleased to note that most students realized that not all minerals and rocks can be easily categorized, and that this was not perceived as a potential problem.

Contrary to the common assumption that preservice elementary teachers dislike math and science, this sample liked math and science more than they dislike the subjects. (4:1 like/dislike) Their prior experiences, which they perceive affected their feelings about teaching science, were more frequently positive than negative. This agrees with data from previous samples studied at C. W. Post College.

Implications

If anxiety about teaching minerals and rocks can be reduced by structured success, the implication is that anxiety about science and science teaching may be reduced by classroom teachers by the identification of subject areas or procedures which evoke anxiety and conscious efforts for structured success. Recently developed "science anxiety clinics", benefit a limited number of volunteer subjects. All students can be reached by the classroom teacher. Because the teacher is consistently cited as the most important influence in students feelings about science and science teaching, it seems reasonable that effective anxiety reduction should take place by direct contact with the stimulus (the teacher and/or classroom situation which evokes anxiety). The reduction of anxiety about science and science teaching should be a concern of researchers in science education.

References

Alvaro, Rosemarie Angela. "The Effectiveness of a Science Therapy Program Upon Science Anxious Undergraduates," unpublished dissertation for the Ph. D., Loyola University, 1979.

Bitner, Gary Faxon. "Competency Measure Feedback Methods as Related to Achievement, Retention, and Attitudes of Students of Different Anxiety in a College Science Laboratory Course", unpublished dissertation for the Ed. D., University of Maryland, 1978.

Gaudry, Eric. "Studies of the Effects of Experimentally Induced Experiences of Success or Failure" in Charles D. Spielberger and Irwin G. Sarason, Eds.. Stress and Anxiety, Volume 4, New York: John Wiley and Sons, 1977.

_____, and Charles D. Spielberger, Anxiety and Academic Achievement. Sidney: Wiley-Australia, 1971.

Harmon, David Jerome. "The Relationships of Student Anxiety and Dependency to the Effects of Teaching Structure on the Learning of Science Knowledge and Processes Within Inductive/Discovery Learning," unpublished dissertation for the Ph. D., The Ohio State University, 1977.

King, F. J., Darlene L. Heinrich, Robert S. Stephenson and Charles D. Spielberger. "An Investigation of the Causal Influence of Trait and State Anxiety on Academic Achievement", Journal of Educational Psychology, 1976, 68:3 330-334.

Kirk, Roger E. Experimental Design: Procedures for the Behavioral Sciences. Belmont, California: Wadsworth, 1968.

Kozma, Robert B. "Instructional Design in a Chemistry Laboratory Course: The Impact of Structure and Aptitudes on Performance and Attitudes," Journal of Research in Science Teaching, March, 1982, 19:3, 261-270.

Mallow, Jeffry V. Science Anxiety: Fear of Science and How to Overcome It. New York: Thomond Press. 1981.

National Science Foundation. Science Education Databook. Washington, D. C.: National Science Foundation, 1980.

Shymansky, James A. "How Teaching Strategies Affect Students: Implications for Teaching Science" in Mary Budd Rowe, Ed. What Research Says to the Science Teacher, Volume 1, Washington, D. C.: National Science Teachers Association, 1978, 31-39.

Spielberger, Charles D., Ed. Anxiety and Behavior. New York: Academic Press, 1966.

_____, Richard L. Gorsuch, and Robert E. Lushene. STAI Manual for the State-Trait Anxiety Inventory. California: Consulting Psychologist Press, 1970.

Terrell, William Reed. "An Exploratory Study of the Modification of Student Anxiety Levels Utilizing Cognitive Style Matching", unpublished dissertation for the Ph. D. Michigan State University, 1974.

Westerback, Mary E. "Four Consecutive Studies on Anxiety About Teaching Science in Preservice Elementary Teachers" in review.

_____, "Studies on Attitude Toward Teaching Science and Anxiety About Teaching Science in Preservice Elementary Teachers," Journal of Research in Science Teaching, Volume 19 to be published.

Appendix

INSTRUCTIONS FOR STAI (A-State, Form Y)

Instructions to be read slowly and clearly by the research assistant before the administration of the STAI (A-State).

IMAGINE that you are a classroom teacher in an elementary school. You are not a science specialists. However, among your other duties you are totally and solely responsible for the teaching of science to your class.

Now please read the directions to yourself for the questionnaire entitled How Do You Feel About Teaching Students to Identify Minerals and Rocks?

In responding to each of the questions, imagine that you are teaching earth science for the first time with the knowledge of geology that you possess right now. Identification is to be based on the following processes: 1. observing, 2. classifying and 3. Inferring.

Any questions ? (Examiner should respond to specific questions that arise by simply repeating the instructions and encourageing the students to use their imagination).

The capitalized or underlined words should be emphasized.

INSTRUCTIONS FOR STAI (A-Trait, Form Y)

Respond to the questionnaire entitled How Do You Feel in General ? by recording your feelings about life in general.